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ABSTRACT

This paper presents a human capital risk analysis that attempts to estimate the effect of increased length of schooling on the amount of risk that impinges on the student in the future, considering earnings in conjunction with investment income. Nonpecuniary returns are ignored. Individuals' actual anticipations of future earnings, needed to compare with actual earnings to determine involuntary variance, were found in the Consumer Anticipation Survey of 3,535 families of above-average income in Boston, Minneapolis, and the San Francisco Bay Area. Each family was visited five times from mid-1968 to the end of 1970. Data calculated from survey results are presented before and after removing extreme outliers from the sample. Under certain assumptions, risk premiums fall with increased schooling length, although part of the fall comes from interaction of education with nonwage income. However, earning variation increases at higher schooling levels, suggesting that advanced education is more "specific" and that the more educated choose riskier investment portfolios. (MJM)

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RISK PREMIUMS AND SCHOOLING CHOICE

by

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I. THE BASIC THEORETICAL FORMULATION

Uncertainty about the effect of schooling on an individual's welfare can take many forms. The human capital approach assumes that the prospective student projects costs and benefits, calculates an approximate rate of return, and compares this rate with the best alternative. Projection involves estimates of ability, quality of educational services, direct and indirect costs, the demand in each year for acquired skills, trends in prices, and countless other variables. There is risk involved in all of these projections and the prospective student is likely to make substantial errors. No attempt will be made in this paper to do a complete analysis of risk and uncertainty. Non-pecuniary costs and returns will generally be ignored and a particular type of risk will be examined -- one in which an investor estimates the parameters of the distribution of yearly earnings (net of direct and indirect investment costs) and makes his decisions according to those parameters. Assume that the student's estimates of mean yearly earnings are unbiased and that the only risk involves his location in the distribution of yearly earnings. The appropriate interest rate to use in discounting the earnings stream is a weighted average of the rate that a student could earn on a marginal non-human capital investment and of the marginal rate at which a student could borrow against his earnings. The weighting factors are the shares in his portfolio of non-wage wealth (NW) and of the net present value (NPV) of his human capital. Assume this rate is determined and that it is non-stochastic. Then,

$$NPV\left(\tilde{Y}^{w}_{t^*+1}, \tilde{Y}^{w}_{t^*+2} \ldots\right) \equiv \tilde{X}_{t^*} = \sum_{t=t^*+1}^{\infty} \frac{\tilde{Y}^{w}_{t}}{(1+i)^{t-t^*}} \qquad (1)$$

$$E(\tilde{X}_{t*}) = \sum_{t=t*+1}^{\infty} \frac{E(\tilde{Y}_t^w)}{(1+i)^{t-t*}} \tag{2}$$

$$\sigma^2_{Xt*} = \sum_{t=t*+1}^{\infty} \frac{\sigma^2_{yt}}{(1+i)^{2(t-t*)}} + 2\sum_{j=t*+2}^{\infty} \sum_{t=t*+1}^{j-1} \frac{\rho_{tj}\,\sigma_{yt}\,\sigma_{yj}}{(1+i)^{t+j-2t*}} \tag{3}$$

where a tilde denotes randomness, i is the individual's opportunity interest rate, Y_t^w is real earnings in year t, X is the NPV of earnings, t varies across ages, t* is the age to which the NPV is calculated and σ^2_{yt} is the "involuntary variance" of earnings in year t "due to schooling." Assume that the investor holds a fixed endowment of NW designated by NW_0. (E.g., he holds 200 shares of General Motors stock and does not add to NW by saving.) Let the value of NW_0 in year t* equal $\widetilde{NW}_{ot*}$. Then, given this endowment, the additional variance attributable to an investment in human capital made in year t* is

$$\sigma^{2\prime}_{Xt*} \equiv \sigma^2_{Xt*} + Cov(\tilde{X}_{t*}, \widetilde{NW}_{0t*}) \quad \text{or} \tag{4}$$

$$\sigma^{2\prime}_{Xt*} = Cov(\tilde{X}_{t*} + \widetilde{NW}_{0t*}, \tilde{X}_{t*}) \tag{5}$$

Some readers have had difficulty understanding the rationale behind equation (4). It is intended to measure the additional variance due to the entire human capital portfolio of, say, a college graduate. It is marginal only in the sense that $\widetilde{NW}_{ot*}$ is given. The margin across educational levels is covered in equation (7a). Equation (5) is the form which appears in the portfolio model of Fama and MacBeth (1973). They show that it is this term which enters the risk premium and thus only one of the two covariance terms in $\mathrm{Var}(\tilde{X}_{t*} + \widetilde{NW}_{Ot*})$ belongs in equation (4). Following Pratt (1964) assume that the investor is risk averse with a risk function r(W) derived from the utility function as follows:

$$r(W) = -\frac{U''(W)}{U'(W)} \tag{6}$$

where W is total wealth. Here $W = E(\tilde{X}_{t*}) + E(\widetilde{NW}_{ot*})$, so

$$r\left[E(\hat{X}_{t*}) + E(\widetilde{NW}_{Ot*})\right] = -\frac{U''\left[E(\tilde{X}_{t*}) + E(\widetilde{NW}_{Ot*})\right]}{U'\left[E(\tilde{X}_{t*}) + E(\widetilde{NW}_{Ot*})\right]} \tag{6a}$$

Given these assumptions and certain regularity conditions, Pratt (1964. p. 125) determines π_{t*}, the absolute risk premium for an investment X_{t*} as

$$\pi_{t*} = \frac{1}{2}\sigma^{2\prime}_{Xt*}\, r\left[E(\hat{X}_{t*}) + E(\widetilde{NW}_{Ot*})\right] + \text{higher order terms} \tag{7}$$

However, this is not an appropriate risk premium for investments in education, since it assumes that the forsaken opportunity is riskless. As Becker states, "A college graduate is ... also a high school graduate and an elementary school graduate. Therefore, a person deciding whether to go to college wants to know how much additional variation is caused by going, in the same way that nonwhites want to know how much additional discrimination results from moving to a higher educational level." (1964, p. 107, emphasis in the original.) Equation (6) can be used to calculate the change in π_{t*} due to a change in educational level, the "marginal risk premium." Ignoring higher order terms

$$\frac{\Delta \pi_{t*}}{\Delta Ed} \cong \frac{1}{2} \left\{ r_0 [E(\tilde{X}_{t*}) + E(\widetilde{NW}_{0t*})] \frac{\Delta \sigma^{2'}_{Xt*}}{\Delta Ed} + \sigma^{2'}_{0Xt*} \frac{\Delta r [E(\tilde{X}_{t*}) + E(\widetilde{NW}_{0t*})]}{\Delta Ed} + \frac{\Delta \sigma^{2'}_{Xt*} \, \Delta r [E(\tilde{X}_{t*}) + E(\widetilde{NW}_{0t*})]}{\Delta Ed} \right\} \quad (7a)$$

where ΔEd is the change in years of schooling and the subscript 0 implies evaluation at the original educational level. $\Delta\pi_{t*} / \Delta Ed$ represents the change in the risk premium per year of additional schooling for a given individual. Clearly it can be either positive or negative, depending on the utility function chosen and on the change in $\sigma^{2'}_{Xt*}$. This formulation can be used to demonstrate the difficulties inherent in Becker's measure of marginal risk, the variation in the rate of return (1964, p. 107). Assume a utility function $[\text{viz. } U(W) = -e^{-cW} \quad c>0]$ which yields constant absolute risk aversion, $\{\text{i.e., } \quad r[E(\tilde{X}_{t*}) + E(\widetilde{NW}_{0t*})] = c.\}$

Then, if the variance of the rate of return replaces $\Delta\sigma^{2'}_{Xt*}/\Delta Ed$ in equation (7), the resultant marginal risk premium could never be negative (since any variance must be positive.) Clearly, however, $\Delta\sigma^{2}_{Xt*}/\Delta Ed$ <u>can</u> be negative which would yield a negative risk premium under the assumed utility function. Becker's measure is incapable of showing this fall in "risk" across educational levels and is therefore incorrect.

Further discussion in this paper will center around the effect of the marginal risk premium on the rate of return to education. Since this rate is equal to the proportion of NPV represented by average yearly earnings, it is appropriate to define a proportional premium to study the effect of uncertainty on this rate. Equation (6) becomes

$$\pi^{P}_{t*} \equiv \frac{\pi_{t*}}{E(\tilde{X}_{t*})} \cong \frac{1}{2}\,\frac{\sigma^{2'}_{Xt*}}{E(\hat{X}_{t*})}\, r\left[E(\hat{X}_{t*}) + E(\widetilde{NW}_{0t*})\right] \tag{8}$$

and the marginal risk premium becomes

$$\frac{\Delta\pi^{P}_{t*}}{\Delta Ed} \cong \Bigg\{ \frac{\Delta\left[\sigma^{2'}_{Xt*}/E(\tilde{X}_{t*})\right]}{\Delta Ed}\, r_0\left[E(\hat{X}_{t*}) + E(\widetilde{NW}_{0t*})\right]$$

$$+ \frac{\sigma^{2'}_{0Xt*}}{E(\hat{X}_{t*})}\,\frac{\Delta r\left[E(\hat{X}_{t*}) + E(\widetilde{NW}_{0t*})\right]}{\Delta Ed}$$

$$+ \frac{\Delta\left[\sigma^{2}_{Xt*}/E(\hat{X}_{t*})\right]\Delta r\left[E(\hat{X}_{t*}) + E(\widetilde{NW}_{0t*})\right]}{\Delta Ed}\Bigg\} \tag{9}$$

Therefore, assuming that a prospective student has calculated a potential rate of return to schooling by summing discounted point estimates of yearly earnings, that value will be adjusted upward or downward as $\Delta\pi^{P}_{t*}/\Delta Ed$ is negative or positive, respectively. Obviously such a calculation is exceedingly difficult for a typical student to make but it can be simplified somewhat, at least if the investor has read Mincer's "Schooling, Age, and Earnings" (1972). As was stated above, $\sigma^{2'}_{Xt*}$ in equation (9) represents "involuntary variance due to schooling." Only that part of the cross-sectional variance which is due to errors in forecasting enters. Further, the variance due to on-the-job training costs and returns is not relevant. Therefore, the investor is viewed as taking two random samples of persons of ability and other relevant factors equal to his own. He takes sample means and "involuntary variances" at the respective "overtaking ages" (the age where the effect of on-the-job training on both values is presumably smallest) for the student's current schooling level and for the next level. Assume, as Mincer does, that the portion of earnings due to schooling rises immediately after the completion of schooling to a constant level which continues until retirement. Assume infinite life. Then the student needs only one sample value to compute NPV (earnings) since

$$\bar{X}_{t*} = \sum_{t=t*+1}^{\infty} \frac{\bar{Y}^{w}_{OT}}{(1+i)^{t-t*}} - C$$

$$= \frac{\bar{Y}^{w}_{OT}}{i} - C \qquad (10)$$

where $\bar{Y}^{w}_{OT}$ = the mean earnings at the overtaking age and C=the NPV of costs. Similarly, assume that the sample involuntary variance at the overtaking age ($S^{2'}_{yOT}$) is a correct estimator of the variance due to schooling for the first year after completion (year t*+1). Assume that the additional uncertainty about returns in later years can be adequately represented by an exponential growth factor γ applied to $S^{2'}_{yOT}$.

$$\left[\text{I.e.} \quad S^{2'}_{yt} = S^{2'}_{yOT}(1+\gamma)^{t-t^*}.\right]$$

Also, assume that the sample serial correlation taken at the overtaking age ($\rho_{OT,OT-1}$) is the appropriate estimate of serial correlation due to schooling. Then,

$$S^{2'}_{yOT} = S^{2}_{yOT} + \mathrm{Cov}(Y^{w}_{OT}, Y^{nw}_{OT}) \tag{11}$$

where Y^{nw}_{OT} is non-wage earnings, and

$$S^{2'}_{Xt^*} = \sum_{t=t^*+1}^{\infty} S^{2'}_{yOT}\left(\frac{1+\gamma}{1+i}\right)^{2(t-t^*)} + 2\sum_{j=t^*+2}^{\infty}\sum_{t=t^*+1}^{j-1} \frac{\rho_{OT,OT-1}\, S^{2'}_{yOT}}{(1+i)^{t+j-2t^*}} \tag{12}$$

$$S^{2'}_{Xt^*} = S^{2'}_{yOT}\left\{I + 2\left[\frac{1}{(1+i)^2-1}\right]\left[\frac{\rho_{OT,OT-1}}{1+i-\rho_{OT,OT-1}}\right]\right\} \tag{12a}$$ [1]

with $$I = \frac{(1+\gamma)^2}{(1+i)^2-(1+\gamma)^2}$$

[1] For derivation, see appendix.

Note that γ must be less than i for the first sum in equation (12) to converge. An estimate of the marginal risk premium is given by

$$\frac{\Delta \hat{\pi}^{p}_{t*}}{\Delta Ed} \cong \frac{1}{2}\left\{ \frac{\Delta\left[\frac{S^{2'}_{xt*}}{\bar{X}_{t*}}\right]}{\Delta Ed} r_0 \left[\bar{X}_{t*} + \overline{NW}_{0t*}\right] + \frac{S^{2'}_{0xt*}}{\bar{X}_{t*}} \frac{\Delta r\left[\bar{X}_{t*} + \overline{NW}_{0t*}\right]}{\Delta Ed} + \frac{\Delta\left[\frac{S^{2'}_{xt*}}{\bar{X}_{t*}}\right] \Delta r \left[\bar{X}_{t*} + \overline{NW}_{0t*}\right]}{\Delta Ed} \right\} \tag{13}$$

Equation (13) can be expressed more compactly under the assumption of either constant absolute or constant relative risk aversion.

1. Constant absolute risk aversion

$$U\left[\bar{X}_{t*} + \overline{NW}_{0t*}\right] = -\exp\left\{-K_1 (\bar{X}_{t*} + \overline{NW}_{0t*})\right\} \tag{14}$$

$$\Rightarrow r\left[\bar{X}_{t*} + \overline{NW}_{0t*}\right] = K_1 \tag{15}$$

$$\Rightarrow \hat{\pi}^{p}_{t*} \cong \frac{1}{2} K_1 \left[\frac{S^{2'}_{xt*}}{\bar{X}_{t*}}\right] \tag{16}$$

$$\frac{\Delta \hat{\pi}^{P}_{t*}}{\Delta Ed} \cong \frac{1}{2} K_1 \left\{ \frac{\Delta \left(\frac{S^{2\prime}_{xt*}}{\bar{X}_{t*}} \right)}{\Delta Ed} \right\} \tag{17}$$

2. Constant relative risk aversion

$$U\left[\bar{X}_{t*} + \overline{NW}_{0t*}\right] = -\left[\bar{X}_{t*} + \overline{NW}_{0t*}\right]^{1-K_2}, \quad K_2 > 1 \tag{18}$$

$$r\left[\bar{X}_{t*} + \overline{NW}_{0t*}\right] = \frac{K_2}{\bar{X}_{t*} + \overline{NW}_{0t*}} \tag{19}$$

$$\hat{\pi}^{P}_{t*} \cong \frac{1}{2} K_2 \left\{ \frac{S^{2\prime}_{xt*}}{\bar{X}_{t*}\left(\bar{X}_{t*} + \overline{NW}_{0t*}\right)} \right\} \tag{20}$$

$$\frac{\Delta \hat{\pi}^{P}_{t*}}{\Delta Ed} \cong \frac{1}{2} \left\{ \frac{\Delta \left[\frac{S^{2\prime}_{xt*}}{\bar{X}_{t*}\left(\bar{X}_{t*} + \overline{NW}_{0t*}\right)} \right]}{\Delta Ed} \right\}, \tag{21}$$

Constant relative risk aversion is the more credible assumption, since it effectively assumes a wealth elasticity for gambling of unity. However, results will be stated under both assumptions so that the reader can choose between them as he wishes.

Two more theoretical points must be made before proceeding:

1. The marginal risk premium measures the extra uncertainty (positive or negative) of one more year of schooling. But clearly there are different types of education and their effects on uncertainty may not be uniform. The distinction between "specific" and "general" education is crucial here, since even if additional general education reduces uncertainty the presumption must be that specific education increases it. Some educational levels may involve a larger proportion of specific education than others. No attempt will be made in this paper to distinguish between specific and general education.

2. Any measure of actual uncertainty is an estimate of the uncertainty which affects people of that educational level after their occupational choices have been made. Yet, if people with more education are more accurate in maximizing profits or utility under uncertainty, they will tend to enter occupations and choose portfolios of non-wage capital where uncertainty is larger and where their abilities, therefore, are most useful.[1] Thus, even if the ability to handle uncertainty improves with increased schooling, estimates made with actual data may show uncertainty rising. Further, if estimates show a fall in uncertainty, the magnitude of the fall will generally be underestimated.

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[1]Gary Becker suggested this point.

II. PREVIOUS STUDIES OF THE EFFECT OF UNCERTAINTY ON SCHOOLING CHOICE

Becker (1964), Weiss (1972), and Olson (1972), have estimated parameters of the marginal risk premium under a mean-variance approach. As shown above, Becker's treatment appears to be incorrect. Weiss uses a formulation essentially similar to the one in this paper and in my earlier work. These previous attempts to analyze the effect of uncertainty suffer from three major difficulties:

1. By using ages other than those near to Mincer's overtaking age, they confound unnecessarily the effect on uncertainty of schooling and on-the-job training. Becker's book and Weiss' paper cross-classify by age so it is possible to single out the observations that correspond to the overtaking age. This has been done for Weiss' data and his main finding -- that the coefficient of variation falls with increased schooling level -- continues to hold. My own previous paper, in an effort to discuss the impact of uncertainty on Negroes, uses data which is not broken down by age and thus cannot be further refined.

2. They use cross-sectional estimates of variances and coefficients of variation to represent "involuntary" variation. Clearly much cross-sectional variation is due to decisions (region of residence, marital status and number of children, proportion of non-monetary returns from employment, hours worked, etc.) which are wholly or partially voluntary. Such voluntary variation does not belong in the risk premium. Cross-sectional variances rise uniformly with educational levels as does the variance over the mean. (Olson, 1972, Table 1.) So marginal risk premiums under constant absolute risk aversion would be estimated as positive. Coefficients of variation or their square behave erratically,

Sometimes rising with schooling and sometimes falling. Weiss finds a fall in the coefficient of variation (1972, Table 1) while Becker's data show a rise (1964, Table 8, p. 104). After calculating coefficients of variation at the overtaking age using Sol Polachek's tabulations from the 1960 Census 1/1000 Sample, we find that in about half of the cases the coefficient of variation rises with schooling; in about half it falls. Thus, estimates of marginal risk premiums under constant relative risk aversion would have no consistent sign. My previous paper attempted to escape this problem by bringing in differences in unemployment (which clearly falls with educational level) and weeks worked (which rises). Also, I cited the work of Welch (who shows that more educated farmers are better able to choose among new technologies), Michael (who shows that educated people have fewer unwanted children), and Grossman (who shows that the incidence of ill health is smaller among the more educated) to support the contention that a properly defined marginal risk premium is negative. Still, while my argument may have succeeded in casting doubt on cross-sectional measures, it could not convincingly show that they gave the wrong sign to the marginal risk premium.

3. Since none of these studies postulates a particular utility function (and therefore a particular risk function) they can at best only indicate the sign of the marginal risk premium and not its magnitude. (They can only give the premium up to a factor of proportionality.)

This paper attempts to partially overcome the first two of these difficulties while remaining guilty of the third. It is able to do this at the cost of a certain amount of generality, due to the existence of a newly available data source, the "Consumer Anticipation Survey" (CAS).

III. THE CONSUMER ANTICIPATION SURVEY

This survey reports on 3,525 households taken evenly from Boston, Minneapolis, and the San Francisco Bay Area over a period of two and one-half years from the middle of 1968 to the end of 1970.[1] Median income of the families in the survey is approximately $16,000 of which about $12,000 is wage income. The average head of household is 30-50 years old. Five separate visits were made (four of which are currently available). Anticipations and later realizations of family income, savings, durable purchases, and other variables were collected. The availability of anticipations and realizations of income is particularly important since it allows calculation of the mean squared error (MSE) within the various schooling classes. The MSE of a schooling class evaluated at its overtaking age is a measure of involuntary variance due to schooling which avoids the difficulties inherent in cross-sectional sample variances. However, the following problems exist with the data, necessitating changes in the theoretical formulation set out in Section 1.

1. The income variable on which anticipations are available is family income, inclusive of all non-wage earnings and of the wage earnings of family members other than the head. The ability to accurately predict this value is obviously important, but it is not the precise variable which is intended to enter the marginal risk premium. A partial reprieve can be gained by use of a bit of statistical sleight of hand which makes income (although still individual rather than family income) the appropriate variable over which to figure errors of

anticipation. Equation (11) gives a form for estimation of involuntary variance in the first year after completion of schooling. An equivalent form is

$$S^{2\prime}_{yOT} = \widehat{Cov}\left(Y_{OT}, Y^{w}_{OT}\right) \tag{21a}$$

which is an estimate of the covariance between income and earnings. S^2_{yOT}, the involuntary variance, was estimated by

$$S^2_{yOT} = MSE = \frac{1}{n}\sum_{i=1}^{n}\left(Y_{68_i} - Y^{e}_{68_i}\right)^2 \tag{21b}$$

where a superscript e denotes an estimated value. A similar estimate of the "involuntary covariance" in equation (21a) is given by

$$S^{2\prime}_{yOT} = \widehat{Cov}\left(Y_{OT}, Y^{w}_{OT}\right) = \frac{1}{n}\sum_{i=1}^{n}\left(Y_{68_i} - Y^{e}_{68_i}\right)\left(Y_{68_i} - Y^{we}_{68_i}\right)$$

$$= \frac{1}{n}\sum_{i=1}^{n}\left(Y_{68_i} - Y^{e}_{68_i}\right)Y^{w}_{68_i} - \frac{1}{n}\sum_{i=1}^{n}\left(Y_{68_i} - Y^{e}_{68_i}\right)Y^{we}_{68_i} \tag{21c}$$

where Y_{68} is 1968 income. The second term in (21c) is a measure of the correlation between the error in prediction of income and the size of Y^{we}_{68}, predicted non-wage earnings; if the mean error is zero it is simply the sample covariance. A problem arises since values for Y^{we}_{68} are not available. However, estimates are made within each education class and a reasonable presumption is that this term is zero. $|Y_{68} - Y^{e}_{68}|$ can be expected to rise as within-class expected non-wage earnings rise but there will be both negative and positive errors. Further, if a systematic correlation existed, estimates could be improved by taking the correlation into account. Therefore, Tables 3A-3E utilize the values of $S^{2'}_{Xt*}$ given by equations (12a) and (21c) under the assumption

that $\frac{1}{n}\sum_{i=1}^{n}\left(Y_{68_i} - Y^{e}_{68_i}\right)Y^{we}_{68_i} = 0$ for all educational classes.

Also, the distinction between $\overline{X}_{t*}$ and $\overline{X}_{t*} + \overline{NPV}_{0t*}$ will be dropped (both will be represented by $\overline{X}_{t*}$) since now $\frac{\overline{Y}_{OT}}{i}$ is really an estimate of the latter. Therefore, equation (17) (under constant absolute risk aversion) becomes

$$\frac{\Delta \hat{\pi}^{p}_{t*}}{\Delta Ed} \cong \frac{1}{2} K_1 \left\{ \frac{\Delta\left[\frac{S^{2'}_{Xt*}}{\overline{X}_{t*}}\right]}{\Delta Ed} \right\} \tag{22}$$

and equation (21) (under constant relative risk aversion) becomes

$$\frac{\Delta \hat{\pi}^{P}_{t^*}}{\Delta Ed} = \frac{1}{2} K_2 \left\{ \frac{\Delta \left[\frac{S'_{x_{t^*}}}{\bar{X}_{t^*}} \right]^2}{\Delta Ed} \right\} \tag{23}$$

Further, there is some unavoidable imprecision in the 1968 and 1969 income values, since they were gathered in November of the respective years before the families had all the relevant information.

2. In order to get large enough sample sizes it was necessary to include all families whose head was aged 30-44. This is obviously not "the" overtaking age, although it probably brackets this age, at least for those with partial or complete college education. Even using these ages the lowest educational class (one to three years of high school) had only 41 or 42 observations, depending on the sample used, so results for that class should be viewed skeptically.

3. No compatible data on educational costs were available so costs are ignored. Effectively the C in equation (10) is set equal to zero.

4. The marginal risk premium is intended to contain the difference in whatever measure of variation is being used between an actual state and the state <u>the same person</u> would have attained if he had a different amount of education. The survey, of course, contains no direct

information on alternative states for given individuals, and it has no indicators of ability or family background which could be used in an adjustment. Therefore, it will be assumed that incomes and variances of those in other educational classes accurately represent the foregone alternatives of those in the sample.

IV. EMPIRICAL RESULTS

The remainder of this paper contains an attempt to estimate the arguments of the marginal risk premium using various values of the parameters under the two assumptions of constant absolute and constant relative risk aversion. This allows estimation of the marginal risk premium up to a factor of proportionality, a fact which should be borne in mind while reading the tables. Therefore, for any variable, proportional differences across schooling classes are more important than magnitude. The argument of equation (22) is $\frac{\Delta\left[S^{2\prime}_{Xt*}/\overline{X}_{t*}\right]}{\Delta Ed}$

(the change in the variance of the NPV over its mean) and that of equation (23) is $\frac{\Delta\left[S^{\prime}_{Xt*}/\overline{X}_{t*}\right]^2}{\Delta Ed}$ (the change in the square of the coefficient of variation). These are the values which will be estimated.

Tables 1A and 1B contain estimates of the basic input parameters and of some statistics which enter only indirectly. Y^e_{68} is the only income anticipations variable used since 1969 anticipations were in probability form with no point estimate. An adjustment has been made in Y^e_{68} to take account of the fact that anticipations and realizations of real (as opposed to nominal) income values are desired. The CAS contains anticipations of price changes from November 1967 to November 1968 in grouped form.

The following approximations were used:

	CAS	P^e
Prices rise:	less than 2%	1.01
	2-4%	1.03
	5-9%	1.07
	10% or more	1.13
	Don't know	1.03
Prices constant:		1.00
Prices fall:		.98
Don't know about rise or fall or missing value:		1.00

The actual change in the overall national Consumer Price Index during this period was .0406 (Monthly Labor Review, November '69, p. 112) and P* was obtained by dividing P^e by 1.0406. Thus, since P* is normalized it is correct to use nominal values of Y_{68} to figure the mean squared error or the first figure in equation (21c) over anticipations of real income. It is obvious from the values for $\overline{P}*$ that this adjustment had very little effect.

Two complete sets of data are included. The CAS contained some severe outliers and the second set of data is estimated with the outlying observations removed from the sample. These data provide a strong object lesson in the use of individual data. To see how outliers can dominate a sample it is sufficient to note that in the partial high school group the removal of a single individual (whose $Y_{68} - Y^e_{68}$ was more than \$50,000) changes the calculated MSE from 36,650,800 to 7,969,840 and the estimate of ρ from .428725 to .818169. Since the change in this person's income from 1967 to 1968 was upward it cannot have resulted from unemployment (I attempted to leave in cases where errors came from unemployment, since this is a possible source of risk). It seems, therefore, that this individual's large year-to-year change resulted from incorrectly reported selling of non-wage capital, winning the Irish Sweepstakes or some similarly unusual event. It seems appropriate to remove such persons for the purpose of studying serial correlations, since what is desired is an estimate of the underlying process by which incomes are generated. I am considerably less sure of the appropriateness of removing outliers when figuring the other parameters, so results are separately stated using the data with and without outliers.

Three estimates of $\rho_{0T,0T-1}$ were made. $\hat{\rho}$ is derived from estimating the regression

$$\begin{bmatrix} Y_{69adj_i} \\ Y_{68adj_i} \end{bmatrix} = \alpha + \rho \begin{bmatrix} Y_{68_i} \\ Y_{67_i} \end{bmatrix} + \epsilon_1 \qquad (24)$$

for each educational group with the outliers remaining in the sample. Here Y_{69adj_i} is adjusted 1969 income for individual i. The adjustment is a crude attempt to take out the time trend. I.e., $Y_{69adj_i} = Y_{69_i} - (\overline{Y}_{69_i} - \overline{Y}_{67_i})$. Similarly $Y_{68adj_i} = Y_{68_i} - (\overline{Y}_{69_i} - \overline{Y}_{67_i})/2$. Thus $\hat{\rho}$ represents an approximation of the tendency for the income of an individual to remain off its trend once departing from that trend. The estimation equation used for $\hat{\rho}^*$ was the same as that used for $\hat{\rho}$, except that the outliers were removed from the sample. Plots of Y_{69_i} against Y_{68_i} and of Y_{68_i} against Y_{67_i} showed evidence of heteroscedesticity and, although I have not yet explicitly checked this assumption, it appears that the variance of the error term rises approximately as the square of the independent variable. Thus $\hat{\rho}^{**}$ is derived from an estimation of

$$\begin{bmatrix} Y_{69adj_i} / Y_{68_i} \\ Y_{68adj_i} / Y_{67_i} \end{bmatrix} = \rho^{**} + \beta \begin{bmatrix} 1 / Y_{68_i} \\ 1 / Y_{67_i} \end{bmatrix} + \epsilon_2 \quad (25)$$

There is, however, some question about whether a high serial correlation indicates more uncertainty or less. The fact that it enters as a positive term in the variance of the NPV would seem to imply that high serial correlations increase uncertainty. In fact, it is true that, viewed from the age (say 17) where the schooling decision is being made, higher serial correlations do increase the expected error. Yet there is also a sense in which high serial correlations decrease uncertainty since, in years after the completion of schooling, they allow more accurate prediction of near-term incomes. Therefore, the overall effect of the serial correlation on uncertainty is unclear. Estimates of the serial correlation appear to rise with schooling level.

Table 2 gives rudimentary estimates of the variance over the mean and of the square of the coefficient of variation. These are proportional to the arguments in the marginal risk premium, since the factor by which $S^{2'}_{y0T}$ is multiplied to get $S^{2'}_{Xt*}$ is smaller than that by which $\overline{Y}_{0T}$ is multiplied to get $\overline{X}_{t*}$. So that, as long as the rates of discount applicable to all schooling levels are equal and serial correlation is ignored, the exclusion of these terms merely changes all figures by a proportional amount. Given these assumptions the sign of changes across schooling levels is correct for any variable. Estimates of the variance over the mean definitely rise with schooling level, and although the direction of change in the squared coefficient of variation is not always consistent, the general trend appears to be upward. This, if marginal risk premiums were estimated using these cross-sectional values they would definitely be positive under constant absolute risk aversion and probably (although with less certainty) positive under constant relative risk aversion.

Tables 3A-3E contain estimates of $S^{2'}_{Xt*}/\overline{X}_{t*}$ and $[S'_{Xt*}/\overline{X}_{t*}]^2$ under various assumptions about i, P, and γ. In the first set of estimates of each part of Table 3, 9 percent is used for all schooling levels. The second set is calculated using 11 percent, 10 percent, 9 percent, and 8 percent, and the third set using 19 percent, 14 percent, 9 percent, and 4 percent. The first and third sets are intended mainly as extremes. Since estimates of the marginal risk premium are only correct up to a factor of proportionality, the level of discount rates used is less important than their proportional differences. There is a strong presumption that the appropriate rates fall with schooling level, but it is unlikely that the rate of fall is as large as that implied by the third set of rates. As stated in Section I the appropriate rate is a weighted average of the return individuals can earn on marginal investments in NW and the cost to them of marginal borrowing against their earnings, weighted by the shares in their portfolios on NW and the NPV of human capital respectively. Given the predominance of wage earnings over non-wage earnings for this group (approximately $12,000 to approximately $4,000) the borrowing rate is more significant. College students can borrow at subsidized rates in some cases, but this is usually not the marginal rate. Mortgage rates (also sometimes subsidized) tend to show small variation across borrowers at a point in time, while the variation in rates charged on installment loans is often large. A further reason to expect the appropriate discount rate to be lower for higher schooling levels is that the rate of return we are trying to calculate is the private rate. The income tax deduction for interest payments is larger for those with higher income (higher schooling), so even if before-tax rates were equal, after-tax rates would have the indicated pattern. Rates chosen approximate mortgage rates in their degree of dispersion. The rates 11 percent, 10 percent, 9 percent, 8 percent may be bunched too closely together. However, it was thought better to err in this direction than in the direction of too much dispersion to insure that differences in interest rates across schooling levels not dominate differences in MSE and $\hat{\rho}_{OT,OT-1}$ (which are presumably estimated more precisely).

A similar rationale was used in changing the formula for $S^{2'}_{Xt*}$ from its form in equation (12a) to the expression that appears at the top of Table 3A. The calculations in all tables were originally made using equation (12a), but the effect was to allow changes in the estimate of $\hat{\rho}_{OT,OT-1}$ to completely swamp changes in MSE. The factor by which MSE is multiplied in the equation took a large jump at one to three years college and fell off sharply for college graduates. Although equation (12a) is presumably correct theoretically and mathematically, it pushes the crude (and crudely trend-adjusted) estimate of $\rho_{OT,OT-1}$ too hard. It was decided that an appropriate compromise was estimation of $S^{2'}_{Xt*}$ using all terms in $\hat{\rho}_{OT,OT-1}$ and all terms in $\hat{\rho}^2_{OT,OT-1}$ but dropping the higher order terms in $\hat{\rho}_{OT,OT-1}$. This compromise yields the formula for $S^{2'}_{Xt*}$ shown at the top of Table 3A.

The values used for γ were chosen in a fashion analogous to that used for i. The calculations with $\gamma = 0$ are intended as a benchmark. $\gamma = .03$ seems to be a more realistic level (subject to the restriction that $\gamma < i$) but my expectation is that an appropriate set of values for γ would be smaller for higher educational levels. So the set .04, .035, .03, .025 is probably more reasonable. Recalling that it is the <u>proportional</u> fall across educational levels which affects the marginal risk premium, the set .05, .04, .03, .02 is probably too extreme.

Considering the values of i, $\hat{\rho}$ and γ, it is reasonable to suppose that the most accurate set of estimates of $S^{2'}_{Xt*}/\overline{X}_{t*}$ and $[S'_{Xt*}/\overline{X}_{t*}]^2$ are those marked 6 in any of the tables. The A tables use estimates of $\hat{\rho}$ and other parameters with outliers included in the data set. The B and D Tables use estimates of $\hat{\rho}*$ and $\hat{\rho}**$ respectively from which outliers have been removed, but all other calculations are made with the outliers in. The C and E Tables are estimated with outliers removed for all calculations. Tables 3A-3E estimate $S^{2'}_{yOT}$ in accord with equation (21c) (I.e., taking account of the covariance of wage with non-wage earnings). Tables 4A-4E contain the same calculations as 3A-3E except that $S^{2'}_{yOT}$ is estimated by the MSE. This set of estimates may be more useful than those in Table 3 if, for instance, the assumption that the second term in equation (21c) is zero is incorrect. Note also that the difference in values between Table 4 and Table 3 allows more subtle separation of the effects of schooling on ability to process information versus choice with respect to riskiness of portfolios.

Tables 5A, 5B, 6A and 6B take account of the schizophrenic effect of an increase in $\hat{\rho}_{OT,OT-1}$ on efficiency of prediction. In these tables estimates of $S^{2'}_{Xt*}$ are calculated without their serial correlation terms. In a similar distinction to that between Tables 3 and 4, Tables 5A and 5B use the covariance term as an estimate of $S^{2'}_{Xt*}$ while 6A and 6B use the MSE.

Examination of Tables 3, 4, 5 and 6 sheds light on the behavior and sign of the marginal risk premium. Further discussion will concentrate on the estimates marked (6) in tables 3C, 3E, 4C and 4E, since it is my belief that the assumptions underlying these estimates are the most credible. Few of the sets of assumptions are extreme, however, so the reader is invited to compare and contrast other computed values. From examination of the above-listed estimates it is apparent that the general trend in $S^{2'}_{Xt*}/\overline{X}_{t*}$ over educational levels is upward. Thus marginal risk premiums assuming constant absolute risk aversion would be positive. Values for $[S'_{Xt*}/\overline{X}_{t*}]^2$ show a less clear pattern. Comparing 3C with 4C, the figures in 3C tend generally to fall with educational level while those in 4C tend to rise. This implies that introduction of the covariance effect between Y^{w}_{OT} and Y^{nw}_{OT} pulls the marginal risk premium downward. Thus, on average over all educational levels, a part of the return to education appears to come in the form of lessened variability in non-wage returns. Similarly, comparing 3E with 4E, the values in 3E tend to fall, those in 4E to rise. If the fact that 3E and 4E are calculated with $\hat{\rho}$** (which makes use of a variance stabilizing transformation) renders them more accurate than 3C and 4C, a further interesting fact emerges. Note that in 3E and 4E the estimates rise from partial to complete college, implying that a greater portion of this increment in schooling is specific. Also the degree of rise is greater in 3E than in 4E, implying that college graduates hold relatively risky portfolios of NW.

V. CONCLUSIONS

Many assumptions were made in this paper, so any conclusions must be conditional on their logic. It was implicitly assumed that the individuals in the "Consumer Anticipation Survey" are representative of the population as a whole. Also, educational costs were excluded. Inclusion of these costs would have allowed this piece to tie more directly into a substantial body of writing.

No definitive sign emerges for the marginal risk premium although under constant relative risk aversion there is a slight presumption that it is negative. This lack of a firm sign for the marginal risk premium in no way precludes the likelihood that more educated people are better able to process information. The central problem to be studied involves a mean-variance tradeoff, and a positive return to schooling in the processing of information requires only that <u>either</u> the mean increase or the marginal risk premium decrease with increases in schooling. The risk premium which can be found empirically is a hybrid of changes in ability to process information and changes in the riskiness of jobs and NW portfolios chosen. (See the last paragraph of Section I.)

This paper makes a significant advance over previous work by its use of either the mean squared error or equation (21c) as a measure of involuntary variance. Also my attempt to use ages near Mincer's overtaking age reduces the effect of on-the-job training on that measure. The effect of these improvements must be a clarification of the nature of the marginal risk premium, and it is interesting to note that these changes lower estimates of the marginal risk premium under both assumptions about the wealth elasticity of risk aversion. (This can be clearly seen by comparing Table 2 with Tables 3, 4, and 5.)

VI. FUTURE RESEARCH PLANS

In my future research I hope to fill many of the holes remaining in this paper and to treat some related topics. The current tract needs a treatment of educational costs, better estimates of i and γ, a dollar value for $r(W)$, removal of taxes from income figures, and an additional estimate of the MSE. In addition, cogitation and discussion has convinced me that concentrating exclusively on the risk premium causes the treatment in this paper to be incomplete and to pass over some interesting aspects of the rate of return to education in a dynamic context. Specifically, there is a link through search theory between (a) the changes over schooling level in mean earnings which Welch (1970) finds to be positively correlated with technological change and (b) the ups and downs of my marginal risk premium. The fundamental proposition that I will attempt to demonstrate is that education increases the efficiency of search and thus allows an increment to productive capacity under uncertainty which the individual can capture either in the form of higher mean earnings or of a lower risk premium. This proposition, if true, helps to clarify the relation of search, risk, and Welch's "allocative effect" and thus makes the rate of return to education somewhat less of an enigma.

A complete and rigorous empirical study covering the items listed in the above paragraph would probably require use of data sets other than the CAS, but the possibilities within this survey are far from exhausted. The following steps toward a complete study can be taken using the variables available in the CAS:

1) an attempt to make additional estimates of the MSE and of equation (21c) using the 1969 income and income anticipations data. Income anticipations for 1969 lack a point estimate so it will be necessary to construct one from the approximate probability densities which are given. This fact may cause estimates to be unstable but, if the estimated values appear reasonable and behave in a predictable fashion under a few simple tests, they will give added evidence from which to draw (hopefully stronger) conclusions,

2) estimation, broken down by educational level, of γ. The CAS does contain two-year anticipations of some variables, although not of income, and a comparison of errors on one-year anticipations with those on two-year anticipations could yield a rough approximation of γ for each schooling level,

3) more accurate and subtle estimation of i using individual wealth breakdowns in the CAS. An equation relating i to the size of total wealth and its proportion in the form of human capital, total outstanding liabilities, and the variability (Longitudinally, from year to year) in family income could supply an estimate of i for each family. This estimate could then be used to calculate individual NPV's, allowing a more discriminative breakdown of both within-group differences and the differences across educational levels,

4) better estimation of $\rho_{OT,OT-1}$. Current estimates are highly unstable and hopefully a better technique can be found. Certainly it is possible to check whether the "variance stabilizing transformation" used in calculating $\hat{\rho}^{**}$ does, in fact, remove the heteroscedasticity. The tape for 1970, when it is received, will give further values and,

hopefully, cause better convergence between the various estimates of $\rho_{OT,OT-1}$,

5) a preliminary attempt to show that more educated people are more efficient searchers. The CAS contains anticipated and actual selling prices of large durable assets. E.g., a person is asked "About how much do you think your house would sell for on today's market?" (1972, First Visit Questionnaire, p. 9). MSE's could be calculated within each schooling level and a negative estimate of $\frac{\Delta\left(\frac{\sqrt{MSE}}{\text{mean selling price}}\right)}{\Delta Ed}$ would be at least a crude indication that search efficiency increases with schooling,

6) an examination of rates of return calculated over mean earnings and an attempt to show negative correlation between risk premiums and rates of return figured over mean earnings within a schooling level. For implicit rates of return I will look to earnings of the head, rather than family earnings, because family earnings can vary with the number of members employed as well as with the productivity of any member. The problem this variability can cause is readily evident from Table 1 since, in both parts, family income usually falls from HS 1-3 to HS 4 and thus calculated rates of return would be negative. Hopefully this difficulty will be removed when earnings of the head are examined. An estimate of the within-level correlation between rates of return figured over the mean and risk premiums could be made by calculations of these values for certain groups (e.g., "self-employed" and "clerical and sales") whose risk can be expected to be high with those in other occupations.

VII. POLICY RELEVANCE

The material covered in the body of this paper and in the plans for future research is difficult and data requirements are substantial. Further, data problems are exacerbated by the fact that in most cases it is necessary to have actual anticipations of future income in order to construct usable estimates of "involuntary variance." Two types of data sets could be used even if they lacked anticipations (a) cross-sectional sets with an enormous number of observations (e.g., the 1/100 sample from the 1960 Census). In this case, cells could be divided sufficiently finely to yield near homogeneity within each cell, and cross-sectional measures of variance would be acceptable. Or (b) longitudinal samples. In this case, it would be possible to generate individual anticipations using a polynomially-distributed lag function on earnings from previous years. An approximate MSE could then be calculated within each schooling level.

The theoretical approach in this paper substantially enriches the concept of a rate of return to schooling, however, and this enrichment must help to make that statistic a more usable policy tool. For instance, while private rates of return to education clearly take account of risk premiums it has previously been much harder to integrate a treatment of risk into estimated social rates of return. Thus, even if the difficulty of measuring non-monetary costs and returns could be surmounted, a meaningful guide for optimum allocation was not available. Risk premiums cause actual disutility and thus it may be true that for two investments with marginal social rates of return figured over mean earnings of 6 and 10 percent, riskless rates are equivalent and an optimum obtains. If the riskless rate for the 10 percent investment in schooling were smaller than that for the 6 percent investment, it would be appropriate (on efficiency grounds) to spend relatively more on the 6 percent investment. Use of the theory and empirical work outlined above can allow this distinction to be recognized theoretically and implemented at least partially. In fact, the usefulness of this treatment is not confined to schooling choices. Various other types of investment in human capital (migration, OJT) involve trading one income stream for another and the above analysis is applicable in untangling the complexities in their rates of return and in allocating money between and among their variants.

Therefore, although application of the results and procedures outlined above will in most cases be partial and involve substantial margins of error it can be helpful in making most qualitative and some quantitative choices in the allocation of public funds. Further, data applicable to schooling and other areas of human capital are becoming increasingly sophisticated. This analysis can be an aid both in choosing the kinds of data to be collected and in making full use of better data when they become available.

TABLE 1A

Basic Statistics with Outliers Not Removed

	HS 1-3	HS 4	COLL 1-3	COLL 4
N	42	269	291	577
$\bar{Y}_{68}$	15628.5	14671.7	16897.8	19513.3
$Var(Y_{68})$	21264900	50624300	62145400	99039100
$\bar{Y}^e_{68}$	13637.1	13676.7	16141.8	18417.1
$\bar{Y}_{69}$	16754.1	15919.2	19281.1	21030.7
$\bar{Y}_{67}$	12806.0	13597.2	15033.6	17930.0
$\sum_{i=1}^{N} (Y_{68_i} - Y^e_{68_i}) Y^w_{68_i}$	29928700	21419500	19467300	35442800
MSE	36650800	26396500	26181200	39985700
Mean Error	1991.39	955.076	775.979	1096.11
Mean Absolute Proportional Error	.161642	.193795	.206405	.204395
P^e	1.03833	1.04810	1.04539	1.04274
P^*	.99782	1.00721	1.00461	1.00206
β	.428725	.809206	.954226	.879883

TABLE 1B

Basic Statistics with Outliers Removed

	HS 1-3	HS 4	COLL 1-3	COLL 4
N	41	266	286	572
$\bar{Y}_{68}$	14782.8	14485.3	16800.9	19445.8
$Var(\bar{Y}_{68})$	19025700	469346	61434700	98354300
$\bar{Y}^{e}_{68}$	13592.8	13714.8	16106.9	18438.2
$\bar{Y}_{69}$	16766.4	15869.2	19257.9	21048.3
$\bar{Y}_{67}$	12784.7	13689.8	15011.3	17849.4
$\frac{1}{n}\sum_{i=1}^{n}(Y_{68_i}-Y^{e}_{68_i})Y^{w}_{68_i}$	19440100	13748900	16627600	29163700
MSE	7929840	19114400	25061500	35315400
Mean Error	1190.06	770.497	693.991	1007.62
Mean Absolute Proportional Error	.148688	.190258	.205682	.203692
P^{e}	1.03902	1.04827	1.04545	1.04285
P^{*}	.998486	1.00737	1.00466	1.00216
$\hat{\rho}^{*}$	.818169	.641670	.918075	.702229
$\hat{\rho}^{**}$	.391675	.553464	.513524	.750867

TABLE 2A

Cross Sectional Estimates of the Arguments
for the Marginal Risk Premium Estimated with Outliers Not Removed

Education	$\left[\frac{S^{2'}_{y_{68}}}{\bar{Y}_{68}}\right]$	$\left[\frac{S'_{y_{68}}}{\bar{Y}_{68}}\right]^2$
HS 1-3	1360.6	.087062
HS 4	3450.5	.235179
COLL 1-3	3657.5	.217645
COLL 4	5075.5	.260103

TABLE 2B

Cross Sectional Estimates of the Arguments
for the Marginal Risk Premium Estimated with Outliers Removed

Education	$\left[\frac{S^{2'}_{y_{68}}}{\bar{Y}_{68}}\right]$	$\left[\frac{S'_{y_{68}}}{\bar{Y}_{68}}\right]^2$
HS 1-3	1151.5	.077895
HS 4	3316.5	.228956
COLL 1-3	3718.6	.221334
COLL 4	4120.9	.211922

TABLE 3A

Arguments for the Marginal Risk Premium Estimated with $\hat{\rho}' = \hat{\rho}$,

Outliers not Removed, for any Calculations, and Using $S^{2'}_{yOT} = \frac{1}{n}\sum_{i=1}^{n}(Y_{68_i} - Y^{e}_{68_i})Y^{w}_{68_i}$,

$$S^{2'}_{Xt*} = \frac{1}{n}\sum_{i=1}^{n}(Y_{68_i} - Y^{e}_{68_i})Y^{w}_{68_i}\left\{I+2\left[\frac{1}{(1+i)^2-1}\right]\left[\frac{\hat{\rho}}{1+i}+\left(\frac{\hat{\rho}}{1+i}\right)^2\right]\right\}, \text{ and } \overline{X}_{t*} = \frac{\overline{Y}_{67}+\overline{Y}_{68}+\overline{Y}_{69}}{3i}$$

	Education	i	γ	$\frac{S^{2'}_{Xt*}}{\overline{X}t*}$	$\left[\frac{S'_{Xt*}}{\overline{X}t*}\right]^2$
1	HS 1-3	.09	0	1992.70	.0119063
	HS 4	.09	0	2495.88	.0152504
	COLL 1-3	.09	0	2337.46	.0123234
	COLL 4	.09	0	3408.61	.0157390
2	HS 1-3	.09	.03	2533.49	.0151375
	HS 4	.09	.03	2891.67	.0176688
	COLL 1-3	.09	.03	2647.84	.0139598
	COLL 4	.09	.03	3903.52	.0180243
3	HS 1-3	.09	.04	2858.15	.0170773
	HS 4	.09	.035	2999.66	.0183286
	COLL 1-3	.09	.03	2647.84	.0139598
	COLL 4	.09	.025	3789.26	.0174967
4	HS 1-3	.11	0	1950.04	.0142406
	HS 4	.10	0	2460.81	.0167068
	COLL 1-3	.09	0	2337.46	.0123234
	COLL 4	.08	0	3459.22	.0141980
5	HS 1-3	.11	.03	2362.76	.0172546
	HS 4	.10	.03	2803.05	.0190304
	COLL 1-3	.09	.03	2647.84	.0139598
	COLL 4	.08	.03	4047.83	.0166139
6	HS 1-3	.11	.04	2579.12	.0188346
	HS 4	.10	.035	2890.85	.0196264
	COLL 1-3	.09	.03	2647.84	.0139598
	COLL 4	.08	.025	3905.09	.0160280
7	HS 1-3	.11	.05	2867.64	.0209415
	HS 4	.10	.04	2993.31	.0203221
	COLL 1-3	.09	.03	2647.84	.0139598
	COLL 4	.08	.02	3786.15	.0155398
8	HS 1-3	.19	.03	2016.80	.0254396
	HS 4	.14	.03	2554.34	.0242786
	COLL 1-3	.09	.03	2647.84	.0139598
	COLL 4	.04	.03	6512.00	.0133639
9	HS 1-3	.19	.04	2109.94	.0266144
	HS 4	.14	.035	2604.45	.0247548
	COLL 1-3	.09	.03	2647.84	.0139598
	COLL 4	.04	.025	5251.27	.0107766

TABLE 3B

Arguments for the Marginal Risk Premium

Estimated with $\hat{\rho} = \hat{\rho}*$, with Outliers not Removed

for Other Calculations, and Using

$$S^{2'}_{yOT} = \frac{1}{n}\sum_{i=1}^{n}(Y_{68_i} - Y^{e}_{68_i})Y^{w}_{68_i}.$$

	Education	i	γ	$\frac{S^{2'}_{Xt*}}{\bar{X}t*}$	$\left[\frac{S'_{Xt*}}{\bar{X}t*}\right]^2$
1	HS 1-3	.09	0	3449.16	.0206086
	HS 4	.09	0	1997.28	.0122038
	COLL 1-3	.09	0	2238.98	.0118042
	COLL 4	.09	0	2713.34	.0125287
2	HS 1-3	.09	.03	3989.94	.0238397
	HS 4	.09	.03	2393.07	.0146222
	COLL 1-3	.09	.03	2549.36	.0134406
	COLL 4	.09	.03	3208.26	.0148139
3	HS 1-3	.09	.04	4314.61	.0257796
	HS 4	.09	.035	2501.06	.0152821
	COLL 1-3	.09	.03	2549.36	.0134406
	COLL 4	.09	.025	3094.00	.0142863
4	HS 1-3	.11	0	3353.07	.0244866
	HS 4	.10	0	1971.65	.0133859
	COLL 1-3	.09	0	2238.98	.0118042
	COLL 4	.08	0	2750.28	.0112882
5	HS 1-3	.11	.03	3765.79	.0275006
	HS 4	.10	.03	2313.90	.0157094
	COLL 1-3	.09	.03	2549.36	.0134406
	COLL 4	.08	.03	3338.90	.0137041
6	HS 1-3	.11	.04	3982.14	.0290805
	HS 4	.10	.035	2401.69	.0163055
	COLL 1-3	.09	.03	2549.36	.0134406
	COLL 4	.08	.025	3196.15	.0131182
7	HS 1-3	.11	.05	4270.66	.0311875
	HS 4	.10	.04	2504.16	.0170011
	COLL 1-3	.09	.03	2549.36	.0134406
	COLL 4	.08	.02	3077.22	.0126301
8	HS 1-3	.19	.03	3232.86	.0407787
	HS 4	.14	.03	2100.41	.0199641
	COLL 1-3	.09	.03	2549.36	.0134406
	COLL 4	.04	.03	5744.21	.0117882
9	HS 1-3	.19	.04	3326.00	.0419535
	HS 4	.14	.035	2150.52	.0204403
	COLL 1-3	.09	.03	2549.36	.0134406
	COLL 4	.04	.025	4438.48	.0092010

TABLE 3C

Arguments for the Marginal Risk Premium
Estimated with $\beta = \beta*$, with Outliers Removed for
Other Calculations, and Using,

$$S^{2'}_{yOT} = \frac{1}{n} \sum_{i=1}^{n} (Y_{68_i} - Y^{e}_{68_i}) Y^{w}_{68_i}$$

	Education	i	γ	$\frac{S^{2'}_{Xt*}}{\overline{X}t*}$	$\left[\frac{S'_{Xt*}}{\overline{X}t*}\right]^2$
1	HS 1-3	.09	0	2283.58	.0139074
	HS 4	.09	0	1286.21	.0078847
	COLL 1-3	.09	0	1917.71	.0101387
	COLL 4	.09	0	2237.63	.0103552
2	HS 1-3	.09	.03	2641.62	.0160878
	HS 4	.09	.03	1541.10	.0094472
	COLL 1-3	.09	.03	2183.56	.0115441
	COLL 4	.09	.03	2645.78	.0122440
3	HS 1-3	.09	.04	2856.57	.0173969
	HS 4	.09	.035	1610.64	.0098735
	COLL 1-3	.09	.03	2183.56	.0115441
	COLL 4	.09	.025	2551.55	.0118080
4	HS 1-3	.11	0	2219.97	.0165244
	HS 4	.10	0	1269.71	.0086484
	COLL 1-3	.09	0	1917.71	.0101387
	COLL 4	.08	0	2268.10	.0093300
5	HS 1-3	.11	.03	2493.22	.0185583
	HS 4	.10	.03	1490.11	.0101496
	COLL 1-3	.09	.03	2183.56	.0115441
	COLL 4	.08	.03	2753.52	.0113268
6	HS 1-3	.11	.04	2636.46	.0196245
	HS 4	.10	.035	1546.65	.0105347
	COLL 1-3	.09	.03	2183.56	.0115441
	COLL 4	.08	.025	2635.80	.0108425
7	HS 1-3	.11	.05	2827.48	.0210464
	HS 4	.10	.04	1612.64	.0109842
	COLL 1-3	.09	.03	2183.56	.0115441
	COLL 4	.08	.02	2537.72	.0104391
8	HS 1-3	.19	.03	2140.38	.0275188
	HS 4	.14	.03	1352.63	.0128985
	COLL 1-3	.09	.03	2183.56	.0115441
	COLL 4	.04	.03	4737.13	.0097432
9	HS 1-3	.19	.04	2202.05	.0283117
	HS 4	.14	.035	1384.90	.0132062
	COLL 1-3	.09	.03	2183.56	.0115441
	COLL 4	.04	.025	3697.44	.0076048

TABLE 3D

Arguments for the Marginal Risk Premium

Estimated with $\hat{\rho} = \hat{\rho}^{**}$, Outliers not Removed

From Other Calculations, and Using

$$S^{2'}_{yOT} = \frac{1}{n} \sum_{i=1}^{n} (Y_{68_i} - Y^e_{68_i}) Y^w_{68_i}$$

	Education	i	Y	$\frac{S^{2'}_{Xt*}}{\overline{X}t*}$	$\left[\frac{S'_{Xt*}}{\overline{X}t*}\right]^2$
1	HS 1-3	.09	0	1879.43	.0112295
	HS 4	.09	0	1761.19	.0107613
	COLL 1-3	.09	0	1301.99	.0068643
	COLL 4	.09	0	2894.50	.0133652
2	HS 1-3	.09	.03	2420.21	.0144607
	HS 4	.09	.03	2156.98	.0131797
	COLL 1-3	.09	.03	1612.37	.0085007
	COLL 4	.09	.03	3389.41	.0156504
3	HS 1-3	.09	.04	2744.88	.0164005
	HS 4	.09	.035	2264.97	.0138395
	COLL 1-3	.09	.03	1612.37	.0085007
	COLL 4	.09	.025	3275.15	.0151228
4	HS 1-3	.11	0	1840.72	.0134423
	HS 4	.10	0	1739.94	.0118127
	COLL 1-3	.09	0	1301.99	.0068643
	COLL 4	.08	0	2934.97	.0120462
5	HS 1-3	.11	.03	2253.44	.0164562
	HS 4	.10	.03	2082.18	.0141362
	COLL 1-3	.09	.03	1612.37	.0085007
	COLL 4	.08	.03	3523.59	.0144622
6	HS 1-3	.11	.04	2469.79	.0180362
	HS 4	.10	.035	2169.98	.0147323
	COLL 1-3	.09	.03	1612.37	.0085007
	COLL 4	.08	.025	3380.84	.0138763
7	HS 1-3	.11	.05	2758.31	.0201432
	HS 4	.10	.04	2272.44	.0154280
	COLL 1-3	.09	.03	1612.37	.0085007
	COLL 4	.08	.02	3261.90	.0133881
8	HS 1-3	.19	.03	1921.36	.0242357
	HS 4	.14	.03	1885.01	.0179167
	COLL 1-3	.09	.03	1612.37	.0085007
	COLL 4	.04	.03	5944.07	.0121984
9	HS 1-3	.19	.04	2014.50	.0254105
	HS 4	.14	.035	1935.13	.0183930
	COLL 1-3	.09	.03	1612.37	.0085007
	COLL 4	.04	.025	4683.34	.0096111

TABLE 3E

Arguments for the Marginal Risk Premium
Estimated with $\hat{\rho} = \hat{\rho}^{**}$, Outliers Removed
From Other Calculations, and Using

$$S^{2'}_{yOT} = \frac{1}{n}\sum_{i=1}^{n}(Y_{68_i} - Y^{e}_{68_i})Y^{w}_{68_i}$$

Group	Education	i	γ	$\frac{S^{2'}_{Xt*}}{\bar{X}t*}$	$\left[\frac{S'_{Xt*}}{\bar{X}t*}\right]^2$
1	HS 1-3	.09	0	1244.31	.0075780
	HS 4	.09	0	1134.18	.0069527
	COLL 1-3	.09	0	1115.17	.0058957
	COLL 4	.09	0	2387.03	.0110466
2	HS 1-3	.09	.03	1602.35	.0097585
	HS 4	.09	.03	1389.06	.0085152
	COLL 1-3	.09	.03	1381.02	.0073012
	COLL 4	.09	.03	2795.18	.0129354
3	HS 1-3	.09	.04	1817.30	.0110676
	HS 4	.09	.035	1458.61	.0089415
	COLL 1-3	.09	.03	1381.02	.0073012
	COLL 4	.09	.025	2700.95	.0124993
4	HS 1-3	.11	0	1218.68	.0090713
	HS 4	.10	0	1120.49	.0076320
	COLL 1-3	.09	0	1115.17	.0058957
	COLL 4	.08	0	2420.41	.0099565
5	HS 1-3	.11	.03	1491.93	.0111052
	HS 4	.10	.03	1340.89	.0091332
	COLL 1-3	.09	.03	1381.02	.0073012
	COLL 4	.08	.03	2905.83	.0119533
6	HS 1-3	.11	.04	1635.17	.0121714
	HS 4	.10	.035	1397.43	.0095183
	COLL 1-3	.09	.03	1381.02	.0073012
	COLL 4	.08	.025	2788.11	.0114691
7	HS 1-3	.11	.05	1826.19	.0135933
	HS 4	.10	.04	1463.41	.0099678
	COLL 1-3	.09	.03	1381.02	.0073012
	COLL 4	.08	.02	2690.02	.0110656
8	HS 1-3	.19	.03	1272.07	.0163550
	HS 4	.14	.03	1213.92	.0115757
	COLL 1-3	.09	.03	1381.02	.0073012
	COLL 4	.04	.03	4901.95	.0100822
9	HS 1-3	.19	.04	1333.74	.0171479
	HS 4	.14	.035	1246.19	.0118835
	COLL 1-3	.09	.03	1381.02	.0073012
	COLL 4	.04	.025	3862.26	.0079438

Table 4A

Arguments for the Marginal Risk Premium
Estimated with $\hat{\rho} = \hat{\rho}$, Outliers Not Removed
From Any Calculations, and Using $S^{2'}_{yOT} = MSE$

I.e., $$S^{2'}_{Xt*} = MSE \left\{ I + 2 \left[\frac{1}{(1+i)^2 - 1}\right] \left[\frac{\hat{\rho}}{1+i} + \left(\frac{\hat{\rho}}{1+i}\right)^2\right] \right\}$$

	Education	i	γ	$\frac{S^{2'}_{Xt*}}{\bar{X}t*}$	$\left[\frac{S'_{Xt*}}{\bar{X}t*}\right]^2$
1	HS 1-3	.09	0	2440.27	.0145805
	HS 4	.09	0	3075.81	.0187940
	COLL 1-3	.09	0	3143.60	.0165735
	COLL 4	.09	0	3845.51	.0177564
2	HS 1-3	.09	.03	3102.52	.0185374
	HS 4	.09	.03	3563.57	.0217743
	COLL 1-3	.09	.03	3561.03	.0187742
	COLL 4	.09	.03	4403.86	.0203345
3	HS 1-3	.09	.04	3500.10	.0209129
	HS 4	.09	.035	3696.68	.0225875
	COLL 1-3	.09	.03	3561.03	.0187742
	COLL 4	.09	.025	4274.95	.0197393
4	HS 1-3	.11	0	2388.03	.0174391
	HS 4	.10	0	3032.60	.0205888
	COLL 1-3	.09	0	3143.60	.0165375
	COLL 4	.08	0	3902.61	.0160178
5	HS 1-3	.11	.03	2893.43	.0211301
	HS 4	.10	.03	3454.36	.0234522
	COLL 1-3	.09	.03	3561.03	.0187742
	COLL 4	.08	.03	4566.67	.0187434
6	HS 1-3	.11	.04	3158.40	.0230649
	HS 4	.10	.035	3562.57	.0241868
	COLL 1-3	.09	.03	3561.03	.0187742
	COLL 4	.08	.025	4405.62	.0180824
7	HS 1-3	.11	.05	3511.72	.0256451
	HS 4	.10	.04	3688.84	.0250441
	COLL 1-3	.09	.03	3561.03	.0187742
	COLL 4	.08	.02	4271.45	.0175317
8	HS 1-3	.19	.03	2469.79	.0311534
	HS 4	.14	.03	3147.87	.0299199
	COLL 1-3	.09	.03	3561.03	.0187742
	COLL 4	.04	.03	7346.68	.0150768
9	HS 1-3	.19	.04	2583.85	.0325921
	HS 4	.14	.035	3209.62	.0305069
	COLL 1-3	.09	.03	3561.03	.0187742
	COLL 4	.04	.025	5924.36	.0121579

Table 4B

Arguments for the Marginal Risk Premium
Estimated with $\hat{\rho} = \hat{\rho}*$, Outliers Not Removed
From Other Calculations, and Using $S^{2'}_{yOT}$ = MSE

	Education	i	γ	$\frac{S^{2'}_{Xt*}}{\bar{X}t*}$	$\left[\frac{S'_{Xt*}}{\bar{X}\,t*}\right]^2$
1	HS 1-3	.09	0	4223.86	.0252373
	HS 4	.09	0	2461.36	.0150395
	COLL 1-3	.09	0	3011.16	.0158753
	COLL 4	.09	0	3061.12	.0141345
2	HS 1-3	.09	.03	4886.10	.0291942
	HS 4	.09	.03	2949.12	.0180198
	COLL 1-3	.09	.03	3418.59	.0180760
	COLL 4	.09	.03	3619.48	.0167127
3	HS 1-3	.09	.04	5283.69	.0315698
	HS 4	.09	.035	3082.20	.0188330
	COLL 1-3	.09	.03	3428.59	.0180760
	COLL 4	.09	.025	3490.57	.0161175
4	HS 1-3	.11	0	4106.19	.0299864
	HS 4	.10	0	2429.79	.0164962
	COLL 1-3	.09	0	3011.16	.0158753
	COLL 4	.08	0	3102.80	.0127351
5	HS 1-3	.11	.03	4611.61	.0336773
	HS 4	.10	.03	2851.55	.0193596
	COLL 1-3	.09	.03	3428.59	.0180760
	COLL 4	.08	.03	3766.87	.0154607
6	HS 1-3	.11	.04	4876.55	.0356121
	HS 4	.10	.035	2959.75	.0200942
	COLL 1-3	.09	.03	3428.59	.0180760
	COLL 4	.08	.025	3605.82	.0147997
7	HS 1-3	.11	.05	5229.88	.0381923
	HS 4	.10	.04	3086.02	.0209515
	COLL 1-3	.09	.03	3428.59	.0180760
	COLL 4	.08	.02	3471.64	.0142490
8	HS 1-3	.19	.03	3958.97	.0499377
	HS 4	.14	.03	2588.46	.0246029
	COLL 1-3	.09	.03	3428.59	.0180760
	COLL 4	.04	.03	6480.48	.0132992
9	HS 1-3	.19	.04	4073.04	.0513765
	HS 4	.14	.035	2650.22	.0251898
	COLL 1-3	.09	.03	3428.59	.0180760
	COLL 4	.04	.025	5058.16	.0103803

Table 4C

Arguments for the Marginal Risk Premium
Estimated with $\hat{\rho} = \hat{\rho}*$, Outliers Removed From
Other Calculations, and Using $S^{2'}_{y0T}$ = MSE

	Education	i	γ	$\frac{S^{2'}_{Xt*}}{\bar{X}_{t*}}$	$\left[\frac{S'_{Xt*}}{\bar{X}_{t*}}\right]^2$
1	HS 1-3	.09	0	931.50	.0056730
	HS 4	.09	0	1788.16	.0109617
	COLL 1-3	.09	0	2890.42	.0152812
	COLL 4	.09	0	2709.63	.0125395
2	HS 1-3	.09	.03	1077.55	.0065624
	HS 4	.09	.03	2142.51	.0131340
	COLL 1-3	.09	.03	3291.11	.0173996
	COLL 4	.09	.03	3203.87	.0148268
3	HS 1-3	.09	.04	1165.23	.0070964
	HS 4	.09	.035	2239.19	.0137267
	COLL 1-3	.09	.03	3291.11	.0173996
	COLL 4	.09	.025	3089.77	.0142987
4	HS 1-3	.11	0	905.55	.0067405
	HS 4	.10	0	1765.22	.0120234
	COLL 1-3	.09	0	2890.42	.0152812
	COLL 4	.08	0	2746.53	.0112980
5	HS 1-3	.11	.03	1017.01	.0075701
	HS 4	.10	.03	2071.62	.0141105
	COLL 1-3	.09	.03	3291.11	.0173996
	COLL 4	.08	.03	3334.34	.0137160
6	HS 1-3	.11	.04	1075.44	.0080051
	HS 4	.10	.035	2150.23	.0146459
	COLL 1-3	.09	.03	3291.11	.0173996
	COLL 4	.08	.025	3191.79	.0131296
7	HS 1-3	.11	.05	1153.36	.0085851
	HS 4	.10	.04	2241.96	.0152707
	COLL 1-3	.09	.03	3291.11	.0173996
	COLL 4	.08	.02	3073.02	.0126410
8	HS 1-3	.19	.03	873.09	.0112252
	HS 4	.14	.03	1880.49	.0179321
	COLL 1-3	.09	.03	3291.11	.0173996
	COLL 4	.04	.03	5736.36	.0117985
9	HS 1-3	.19	.04	898.24	.0115487
	HS 4	.14	.035	1925.36	.0183599
	COLL 1-3	.09	.03	3291.11	.0173996
	COLL 4	.04	.025	4477.36	.0092090

Table 4D

Arguments for the Marginal Risk Premium
Estimated with $\hat{\rho} = \hat{\rho}^{**}$, Outliers Not Removed
From Other Calculations, and Using $S^{2'}_{y\theta T}$ = MSE

	Education	i	γ	$\frac{S^{2'}_{Xt^*}}{\bar{X}t^*}$	$\left[\frac{S'_{Xt^*}}{\bar{X}t^*}\right]^2$
1	HS 1-3	.09	0	2301.55	.0137517
	HS 4	.09	0	2170.42	.0132618
	COLL 1-3	.09	0	1751.02	.0092317
	COLL 4	.09	0	3265.50	.0150782
2	HS 1-3	.09	.03	2963.80	.0177086
	HS 4	.09	.03	2658.18	.0162421
	COLL 1-3	.09	.03	2168.45	.0114324
	COLL 4	.09	.03	3823.85	.0176564
3	HS 1-3	.09	.04	3361.39	.0200841
	HS 4	.09	.035	2761.26	.0170553
	COLL 1-3	.09	.03	2168.45	.0114324
	COLL 4	.09	.025	3694.95	.0170612
4	HS 1-3	.11	0	2254.15	.0164615
	HS 4	.10	0	2144.23	.0145575
	COLL 1-3	.09	0	1751.02	.0092317
	COLL 4	.08	0	3311.16	.0135903
5	HS 1-3	.11	.03	2759.57	.0201524
	HS 4	.10	.03	2565.99	.0174209
	COLL 1-3	.09	.03	2168.45	.0114324
	COLL 4	.08	.03	3975.22	.0163158
6	HS 1-3	.11	.04	3024.52	.0220872
	HS 4	.10	.035	2674.19	.0181555
	COLL 1-3	.09	.03	2168.45	.0114324
	COLL 4	.08	.025	3814.18	.0156549
7	HS 1-3	.11	.05	3377.84	.0246674
	HS 4	.10	.04	2800.46	.0190128
	COLL 1-3	.08	.03	2168.45	.0114324
	COLL 4	.08	.02	3680.00	.0151041
8	HS 1-3	.19	.03	2352.91	.0296791
	HS 4	.14	.03	2323.01	.0220798
	COLL 1-3	.09	.03	2168.45	.0114324
	COLL 4	.04	.03	6705.96	.0137619
9	HS 1-3	.19	.04	2466.97	.0311178
	HS 4	.14	.035	2384.77	.0226668
	COLL 1-3	.09	.03	2168.45	.0114324
	COLL 4	.04	.025	5283.64	.0108430

Table 4E

Arguments for the Marginal Risk Premium
Estimated with $\hat{\rho} = \hat{\rho}**$, Outliers Removed From
Other Calculations, and Using $S^{2'}_{yOT}$ = MSE

	Education	i	γ	$\frac{S^{2'}_{Xt*}}{\bar{X}t*}$	$\left[\frac{S'_{Xt*}}{\bar{X}t*}\right]^2$
1	HS 1-3	.09	0	507.57	.0309117
	HS 4	.09	0	1576.79	.0096660
	COLL 1-3	.09	0	1680.81	.0088862
	COLL 4	.09	0	2890.54	.0133767
2	HS 1-3	.09	.03	653.62	.0398062
	HS 4	.09	.03	1931.14	.0118382
	COLL 1-3	.09	.03	2081.50	.0110046
	COLL 4	.09	.03	3384.78	.0156640
3	HS 1-3	.09	.04	741.30	.0045146
	HS 4	.09	.035	2027.83	.0124310
	COLL 1-3	.09	.03	2081.50	.0110046
	COLL 4	.09	.025	3270.68	.0151359
4	HS 1-3	.11	0	497.12	.0037003
	HS 4	.10	0	1557.76	.0106104
	COLL 1-3	.09	0	1680.81	.0088862
	COLL 4	.08	0	2930.96	.0120567
5	HS 1-3	.11	.03	608.58	.0045300
	HS 4	.10	.03	1864.17	.0126975
	COLL 1-3	.09	.03	2081.50	.0110046
	COLL 4	.08	.03	3518.77	.0144747
6	HS 1-3	.11	.04	667.01	.0049649
	HS 4	.10	.035	1942.11	.0132329
	COLL 1-3	.09	.03	2081.50	.0110046
	COLL 4	.08	.025	3376.22	.0138883
7	HS 1-3	.11	.05	744.93	.0054486
	HS 4	.10	.04	2034.51	.0138577
	COLL 1-3	.09	.03	2081.50	.0110046
	COLL 4	.08	.02	3257.45	.0133997
8	HS 1-3	.19	.03	518.90	.0066714
	HS 4	.14	.03	1687.65	.0160932
	COLL 1-3	.09	.03	2081.50	.0110046
	COLL 4	.04	.03	5935.95	.0122090
9	HS 1-3	.19	.04	544.05	.0069948
	HS 4	.14	.035	1732.51	.0165210
	COLL 1-3	.09	.03	2081.50	.0110046
	COLL 4	.04	.025	4676.95	.0096195

TABLE 5A

Arguments for the Marginal Risk Premium
Estimated with $\hat{\rho}$ = 0, Outliers not Removed
From Other Calculations, and Using

$$S^{2'}_{yOT} = \frac{1}{n} \sum_{i=1}^{n} (Y_{68_i} - Y^e_{68_i})Y^w_{68_i}$$

	Education	i	γ	$\frac{S^{2'}_{Xt*}}{\bar{X}t*}$	$\left[\frac{S'_{Xt*}}{\bar{X}t*}\right]^2$
1	HS 1-3	.09	0	950.69	.0056803
	HS 4	.09	0	695.80	.0042515
	COLL 1-3	.09	0	545.64	.0028767
	COLL 4	.09	0	870.05	.0040174
2	HS 1-3	.09	.03	1491.48	.0089115
	HS 4	.09	.03	1091.59	.0066699
	COLL 1-3	.09	.03	856.03	.0045131
	COLL 4	.09	.03	1364.96	.0063026
3	HS 1-3	.09	.04	1816.14	.0108514
	HS 4	.09	.035	1199.58	.0073297
	COLL 1-3	.09	.03	856.03	.0045131
	COLL 4	.09	.025	1250.70	.0057750
4	HS 1-3	.11	0	941.67	.0068768
	HS 4	.10	0	692.48	.0047013
	COLL 1-3	.09	0	545.64	.0028767
	COLL 4	.08	0	874.22	.0035882
5	HS 1-3	.11	.03	1354.39	.0098908
	HS 4	.10	.03	1034.72	.0070249
	COLL 1-3	.09	.03	856.03	.0045132
	COLL 4	.08	.03	1462.84	.0060041
6	HS 1-3	.11	.04	1570.74	.0114707
	HS 4	.10	.035	1122.52	.0076201
	COLL 1-3	.09	.03	856.03	.0045131
	COLL 4	.08	.025	1320.09	.0054182
7	HS 1-3	.11	.05	1859.26	.0135777
	HS 4	.10	.04	1224.98	.0083166
	COLL 1-3	.09	.03	856.03	.0045131
	COLL 4	.08	.02	1201.16	.0049300
8	HS 1-3	.19	.03	1127.55	.0142227
	HS 4	.14	.03	904.85	.0086004
	COLL 1-3	.09	.03	856.03	.0045131
	COLL 4	.04	.03	3727.70	.0076499
9	HS 1-3	.19	.04	1220.69	.0153976
	HS 4	.14	.035	954.96	.0090767
	COLL 1-3	.09	.03	856.03	.0045131
	COLL 4	.04	.025	2466.97	.0050627

TABLE 5B

Arguments for the Marginal Risk Premium
Estimated with $\hat{\rho} = 0$, Outliers Removed
From Other Calculations, and Using

$$S^{2'}_{yOT} = \frac{1}{n}\sum_{i=1}^{n}(Y_{68_i} - Y^{e}_{68_i})Y^{w}_{68_i}$$

	Education	i	γ	$\frac{S^{2'}_{Xt*}}{\overline{Xt*}}$	$\left[\frac{S'_{Xt*}}{\overline{Xt*}}\right]^2$
	HS 1-3	.09	0	629.42	.0038332
1	HS 4	.09	0	448.08	.0027468
	COLL 1-3	.09	0	467.35	.0024708
	COLL 4	.09	0	717.51	.0033204
	HS 1-3	.09	.03	987.46	.0060137
2	HS 4	.09	.03	702.97	.0043093
	COLL 1-3	.09	.03	733.19	.0038762
	COLL 4	.09	.03	1125.66	.0052093
	HS 1-3	.09	.04	1202.41	.0073228
3	HS 4	.09	.035	772.51	.0047356
	COLL 1-3	.09	.03	733.19	.0038763
	COLL 4	.09	.025	1031.43	.0047732
	HS 1-3	.11	0	623.45	.0046407
4	HS 4	.10	0	445.95	.0030375
	COLL 1-3	.09	0	467.35	.0024708
	COLL 4	.08	0	720.96	.0029657
	HS 1-3	.11	.03	896.70	.0066746
5	HS 4	.10	.03	666.35	.0045387
	COLL 1-3	.09	.03	733.19	.0038763
	COLL 4	.08	.03	1206.37	.0049625
	HS 1-3	.11	.04	1039.94	.0077408
6	HS 4	.10	.035	722.89	.0049238
	COLL 1-3	.09	.03	733.19	.0038763
	COLL 4	.08	.025	1088.65	.0044782
	HS 1-3	.11	.05	1230.96	.0091627
7	HS 4	.10	.04	788.87	.0053733
	COLL 1-3	.09	.03	733.19	.0038763
	COLL 4	.08	.02	990.57	.0040748
	HS 1-3	.19	.03	746.52	.0095980
8	HS 4	.14	.03	582.71	.0055567
	COLL 1-3	.09	.03	733.19	.0038763
	COLL 4	.04	.03	3074.16	.0063229
	HS 1-3	.19	.04	808.18	.0103908
9	HS 4	.14	.035	614.98	.0058644
	COLL 1-3	.09	.03	733.19	.0038763
	COLL 4	.04	.025	2034.46	.0041844

TABLE 6A

Arguments for the Marginal Risk Premium
Estimated with β = 0, Outliers not Removed
From Other Calculations, and Using

$$S^{2'}_{yOT} = \text{MSE}$$

	Education	i	γ	$\frac{S^{2'}_{Xt*}}{\overline{X}t*}$	$\left[\frac{S'_{Xt*}}{\overline{X}t*}\right]^2$
1	HS 1-3	.09	0	1164.22	.0069561
	HS 4	.C9	0	857.47	.0052394
	COLL 1-3	.09	0	733.83	.0038689
	COLL 4	.09	0	981.57	.0045323
2	HS 1-3	.09	.03	1826.46	.0109130
	HS 4	.09	.03	1345.23	.0082197
	COLL 1-3	.09	.03	1151.25	.0060696
	COLL 4	.09	.03	1539.92	.0065153
3	HS 1-3	.09	.04	2224.05	.0132886
	HS 4	.09	.035	1478.32	.0090329
	COLL 1-3	.09	.03	1151.25	.0060696
	COLL 4	.09	.025	1411.02	.0065153
4	HS 1-3	.11	0	1153.17	.0084213
	HS 4	.10	0	853.39	.0057938
	COLL 1-3	.09	0	733.83	.0038688
	COLL 4	.08	0	986.28	.0040481
5	HS 1-3	.11	.03	1658.59	.0121122
	HS 4	.10	.03	1275.15	.0086572
	COLL 1-3	.09	.03	1151.25	.0060696
	COLL 4	.08	.03	1650.34	.0067737
6	HS 1-3	.11	.04	1923.54	.0140471
	HS 4	.10	.035	1383.35	.0093918
	COLL 1-3	.09	.03	1151.25	.0060696
	COLL 4	.08	.025	1489.30	.0061126
7	HS 1-3	.11	.05	2276.86	.0016627
	HS 4	.10	.04	1509.62	.0102490
	COLL 1-3	.09	.03	1151.25	.0060696
	COLL 4	.08	.02	1355.12	.0055619
8	HS 1-3	.19	.03	1380.80	.0174172
	HS 4	.14	.03	1115.10	.0105988
	COLL 1-3	.09	.03	1151.25	.0060696
	COLL 4	.04	.03	4205.49	.0086305
9	HS 1-3	.19	.04	1494.87	.0188559
	HS 4	.14	.035	1176.85	.0111858
	COLL 1-3	.09	.03	1151.25	.0060696
	COLL 4	.04	.025	2783.17	.0057116

TABLE 6B

Arguments for the Marginal Risk Premium
Estimated with $\hat{\rho} = 0$, Outliers Removed
From Other Calculations, and Using

$$S^{2'}_{yOT} = MSE$$

	Education	i	γ	$\frac{S^{2'}_{Xt*}}{\overline{X}t*}$	$\left[\frac{S'_{Xt*}}{\overline{X}t*}\right]^2$
1	HS 1-3	.09	0	256.75	.0015636
	HS 4	.09	0	622.95	.0038188
	COLL 1-3	.09	0	704.40	.0037241
	COLL 4	.09	0	868.86	.0040209
2	HS 1-3	.09	.03	402.80	.0024531
	HS 4	.09	.03	977.30	.0059916
	COLL 1-3	.09	.03	1105.09	.0058424
	COLL 4	.09	.03	1363.10	.0063081
3	HS 1-3	.09	.04	490.48	.0029871
	HS 4	.09	.035	1073.98	.0065837
	COLL 1-3	.09	.03	1105.09	.0058424
	COLL 4	.09	.025	1249.00	.0057801
4	HS 1-3	.11	0	254.31	.0018930
	HS 4	.10	0	616.98	.0042229
	COLL 1-3	.09	0	704.40	.0037241
	COLL 4	.08	0	873.03	.0035913
5	HS 1-3	.11	.03	365.77	.0027226
	HS 4	.10	.03	926.38	.0063099
	COLL 1-3	.09	.03	1105.09	.0058424
	COLL 4	.08	.03	1460.84	.0060093
6	HS 1-3	.11	.04	424.20	.0031576
	HS 4	.10	.035	1004.99	.0068453
	COLL 1-3	.09	.03	1105.09	.0058424
	COLL 4	.08	.025	1318.29	.0054229
7	HS 1-3	.11	.05	502.12	.0037376
	HS 4	.10	.04	1096.72	.0074702
	COLL 1-3	.09	.03	1105.09	.0058424
	COLL 4	.08	.02	1199.52	.0049343
8	HS 1-3	.19	.03	304.51	.0039151
	HS 4	.14	.03	810.11	.0077251
	COLL 1-3	.09	.03	1105.09	.0058424
	COLL 4	.04	.03	3722.60	.0076566
9	HS 1-3	.19	.04	329.67	.0042385
	HS 4	.14	.035	854.97	.0081529
	COLL 1-3	.09	.03	1105.09	.0058424
	COLL 4	.04	.025	2463.60	.0050671

APPENDIX

DERIVATION OF EQUATION (12a):

LET $\hat{\rho}_{tj} = \hat{\rho}^{(j-t)}_{OT,\,OT-1}$; ASSUME $\hat{\rho}_{OT,\,OT-1} > 0$

$$\text{THEN } S^{2\prime}_{Xt^*} = S^{2\prime}_{YOT}\left(\frac{1+\gamma}{1+i}\right)^{2(t+t^*)} + 2\sum_{j=t^*+2,\,t=t^*+1}^{\infty}\ \sum^{j-1} \frac{\hat{\rho}_{tj}\quad S^{2\prime}_{YOT}}{(1+i)^{t+j-2t^*}}$$

$$\Rightarrow \quad S^{2\prime}_{Xt^*} = S^{2\prime}_{yOT}\left\{I + 2\sum_{j=t^*+2}^{\infty}\left[\frac{\hat{\rho}^{(j-1)}_{OT,\,OT-1}}{(1+i)^{j+1}} + \frac{\hat{\rho}^{(j-2)}_{OT,\,OT-2}}{(1+i)^{j+2}} + \cdots + \frac{\rho^{1}}{(1+i)^{2j-1}}\right]\right\}$$

$$= S^{2\prime}_{yOT}\left\{I + 2\left[\begin{array}{l} \dfrac{\hat{\rho}_{OT,\,OT-1}}{(1+i)^3} + \\[2ex] \dfrac{\hat{\rho}^{2}_{OT,\,OT-1}}{(1+i)^4} + \dfrac{\hat{\rho}_{OT,\,OT-1}}{(1+i)^5} + \\[2ex] \dfrac{\hat{\rho}^{3}_{OT,\,OT-1}}{(1+i)^5} + \dfrac{\hat{\rho}^{2}_{OT,\,OT-1}}{(1+i)^6} + \dfrac{\hat{\rho}_{OT,\,OT-1}}{(1+i)^7} + \\ + \\ \vdots \end{array}\right]\right\}$$

$$= \left\{I + 2\sum_{\ell=1}^{\infty}\sum_{k=0}^{\infty}\frac{\hat{\rho}^{\ell}_{OT,\,OT-1}}{(1+i)^{2k+2+\ell}}\right\}$$

$$= S^{2\prime}_{yOT}\left\{I + 2\sum_{k=0}^{\infty}\sum_{\ell=1}^{\infty}\frac{\hat{\rho}^{\ell}_{OT,\,OT-1}}{(1+i)^{2k+2+\ell}}\right\}$$

$$= S^{2'}_{YOT}\left\{ I + 2\sum_{k=0}^{\infty} \frac{1}{(1+i)^{2(k+1)}} \sum_{\ell=1}^{\infty}\left(\frac{\hat{\rho}_{OT,OT-1}}{1+i}\right)^{\ell}\right\}$$

$$= S^{2'}_{YOT}\left\{ I + 2\sum_{m=1}^{\infty} \frac{1}{(1+i)^{2m}} \sum_{\ell=1}^{\infty}\left(\frac{\hat{\rho}_{OT,OT-1}}{1+i}\right)^{\ell}\right\}$$

$$= S^{2'}_{YOT}\left\{ I + 2\left[\frac{1}{1-\left(\frac{1}{1+i}\right)^{2}} - 1\right]\left[\frac{1}{1-\frac{\hat{\rho}_{OT,OT-1}}{1+i}}\right] - 1\right\}$$

$$\Rightarrow \quad S^{2'}_{Xt*} = S^{2'}_{YOT}\left\{ I + 2\left[\frac{1}{(1+i)^{2}-1}\right]\left[\frac{\hat{\rho}_{OT,OT-1}}{1+i-\hat{\rho}_{OT,OT-1}}\right]\right\}$$

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